instruction manual

F. T. MAINT. LAB

FCD 3P-2000

Sorensen

SORENSEN
A Unit of Raytheon
Richards Avenue, South Norwalk, Connecticut

Model FCD 3P2000

F. T. MAINT. LAB

MP MASTER
MA25455

F. T. MAINT. LAB

FCD 3P-2000

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1. GENERAL SERVICE & WARRANTY INFORMATION

IT IS IMPORTANT THAT YOU READ THIS MANUAL THOROUGHLY. BY DOING THIS, YOU WILL INSURE YOURSELF OF OBTAINING MAXIMUM PERFORMANCE FROM THIS INSTRUMENT.

SHIPPING DAMAGE

AT TIMES, INSTRUMENTS ARE DAMAGED IN TRANSIT. WE STRONGLY ADVISE THAT YOU INSPECT AND TEST YOUR FREQUENCY CHANGER AS SOON AS YOU RECEIVE IT. IF THE FREQUENCY CHANGER IS DAMAGED OR IF IT FAILS TO OPERATE PROPERLY, YOU SHOULD ASK THE CARRIER TO INSPECT THE SHIPMENT. THE CARRIER'S CLAIM AGENT WILL PREPARE A REPORT OF DAMAGE WHICH YOU SHOULD SEND TO US. WE WILL THEN TELL YOU HOW TO HAVE THE INSTRUMENT REPAIRED OR REPLACED.

SERVICE INFORMATION

IF YOU HAVE ANY QUESTIONS ABOUT THE OPERATION, REPAIR, OR SERVICING OF A SORENSEN INSTRUMENT, PLEASE CONTACT OUR LOCAL REPRESENTATIVES. (A LIST OF REPRESENTATIVES IS INCLUDED WITH THIS MANUAL). IF IT IS MORE CONVENIENT, YOU MAY CONTACT US DIRECTLY AT THE SERVICE DEPARTMENT, SORENSEN - A UNIT OF RAYTHEON, RICHARDS AVENUE, SOUTH NORWALK, CONNECTICUT.

IMPORTANT

BE SURE TO INCLUDE THE MODEL & SERIAL NUMBER IN ALL CORRESPONDENCE CONCERNING A SORENSEN INSTRUMENT. WITHOUT THIS INFORMATION WE MAY NOT BE ABLE TO GIVE YOU PROMPT AND ACCURATE SERVICE.

RETURNS TO THE FACTORY

SHOULD YOU DECIDE TO RETURN THIS INSTRUMENT TO US FOR REPAIR, PLEASE CONTACT US FOR AUTHORIZATION TO MAKE SHIPMENT. WE HAVE A NUMBER OF LOCAL SERVICE FACILITIES IN THE UNITED STATES AND CANADA WHICH ARE EQUIPPED AND STAFFED TO PROVIDE YOU WITH FAST, EFFICIENT SERVICE. FOR THIS REASON, WE RESERVE THE RIGHT TO REFUSE UNAUTHORIZED SHIPMENTS TO OUR PLANT. ALL SHIPMENTS TO SORENSEN SHOULD BE PRE-PAID UNLESS WE AUTHORIZE TO THE CONTRARY. THE INSTRUMENT SHOULD BE WRAPPED IN HEAVY PAPER AND PACKED IN THE ORIGINAL CONTAINER OR A WOODEN BOX WITH AT LEAST THREE INCHES OF SHOCK ABSORBENT MATERIAL ON ALL SIDES.

WARRANTY

THIS FREQUENCY CHANGER IS WARRANTED BY SORENSEN - A UNIT OF RAYTHEON TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP. OUR OBLIGATION UNDER THE WARRANTY IS LIMITED TO SERVICING THE INSTRUMENT AND REPLACING DEFECTIVE PARTS WHEN THE INSTRUMENT IS RETURNED TO THE FACTORY WITH TRANSPORTATION CHARGES PRE-PAID. NO OTHER WARRANTIES MAY BE IMPLIED.

THE PERIOD OF WARRANTY IS ONE YEAR AFTER THE DELIVERY OF THE INSTRUMENT TO THE ORIGINAL PURCHASER.

DEFECTS CAUSED BY IMPROPER OPERATING CONDITIONS, ACCIDENTS, MIS-USE, NEGLIGENCE AND THE ALTERATION OR REMOVAL OF THE NAMEPLATE WILL VOID THIS WARRANTY.

NAMEPLATES

SORENSEN STRONGLY ADVISES THAT THE NAMEPLATE BE RETAINED EVEN IF THE INSTRUMENT IS TO BE INCORPORATED INTO OTHER EQUIPMENT. THIS WILL ELIMINATE LATER DIFFICULTIES IF SERVICE OR PARTS ARE REQUIRED.

II. UNIT SPECIFICATIONS

FCD 3P-2000

I. UNIT:

1.	Efficiency	NOMINAL	40 %
2.	Ambient Temp. Range		0 to 35°C (32 to 95°F)
3.	Response Time (see Note 1)	NOMINAL	0.1 seconds
		EXTREME	0.5 seconds
4.	Frequency Dial Calibration		± 2 %
5.	Cooling		Forced Air
6.	Weight		600 lbs.
7.	Dimensions		H-72", W-22", D-18"
8.	Meter Accuracy		± 2 %

II. INPUT:

1.	Voltage Range (see Note 2)	NOMINAL 208 V	± 10 %
		NOMINAL 230 V	± 10 %
2.	Frequency		50 & 60 cps.
3.	Phase		Single phase
4.	Current		30 amp. max.

III. OUTPUT:

1.	Voltage Range	Ø to N 115 V nom.	± 10 %
2.	Frequency	variable	360 to 440 cps.
		fixed	400 ± 0.01% cps.
3.	Load Range	unity to 0.5 lag	0 to 2 KVA
4.	Distortion	balance load	3 % max.
5.	Modulation (see Note 3)		2 % max.
6.	Drift Volts & Frequency at 400 cps.		1 % max.
7.	Regulation:		
	(a) Volts - Balance Load	line to neutral	2 % (±1%)
		*line to line	4 % (±2%)

Conditions: For an input voltage change of (208 ± 10%) (230 ± 10%), a load change of 25% to full load and for any output frequency variations. There is a slight derating at full load of 25% at 360 cps. and between an input voltage range of 188 to 195 volts.

There is an additional derating from 25% to no load 1% (± 0.5%)

* Line to Line voltage have an additional regulation factor due to variations in the three phase angles.

NOTE: UNBALANCED LOADS WILL DETERIORATE LINE TO LINE REGULATION SPECIFICATIONS SLIGHTLY DEPENDING ON THE DEGREE OF UNBALANCE.

(B) FREQUENCY/ALL VARIATIONS - - - - - - - - - - - ± 1 %

8. FREQUENCY DIAL ACCURACY - - - - - - - - - - - - - - - - - ± 2%

NOTE 1. WHEN AN ABRUPT CHANGE OCCURS IN THE INPUT VOLTAGE OR OUTPUT LOAD, AN INSTANTANEOUS CHANGE AT THE OUTPUT VOLTAGE OCCURS. THIS INSTANTANEOUS CHANGE IS QUICKLY SUPPRESSED BY THE REGULATION ACTION OF THE UNIT. RESPONSE TIME IS A MEASURE OF HOW FAST THIS CHANGE IS SUPPRESSED. IT IS DEFINED AS THE TIME NECESSARY FOR THE OUTPUT VOLTAGE TO EFFECT A 63% RECOVERY FROM THE MAXIMUM DEVIATED VALUE, BASED UPON A 10% LINE VOLTAGE CHANGE, OR A 50% STEP CHANGE IN THE LOAD.

NOTE 2. TAPS ARE PROVIDED ON THE INPUT TRANSFORMER FOR EITHER 208 OR 230 VOLT OPERATION.

NOTE 3. THE OUTPUT VOLTAGE MODULATION IS SPECIFIED AS BEING 2% MAXIMUM. THIS FIGURE ASSUMES NO INPUT VOLTAGE MODULATION. IF INPUT MODULATION IS PRESENT, THE OUTPUT MODULATION WILL BE DIRECTLY AFFECTED BY IT. OUTPUT MODULATION IS ALSO REFERRED TO AS "ENVELOPE MODULATION"IS CAUSED BY THE ACTION OF THE INVERTER TUBES. THIS MODULATION IS THE AMPLITUDE VARIATION MEASURED AT EITHER HALF CYCLE FROM MINIMUM PEAK TO MAXIMUM PEAK VALUE.

AUDIO NOISE:

THE AUDIO NOISE LEVEL OF THIS UNIT IS COMPARABLE TO THE NOISE LEVEL OF A QUITE OFFICE. THIS IS APPROXIMATELY 65 DB AT A DISTANCE OF SIX (6) FEET

R.F. NOISE:

SOME R.F. NOISE IS GENERATED BY THIS UNIT AND IS SUPPRESSED BY USE OF INTERNAL FILTERING.

III. INSTALLATION & OPERATION

A. GENERAL

THE FCD 3P-2000, IS DIVIDED INTO THREE SECTIONS, NAMELY UNIT 1, UNIT 2, AND THE MODULE. UNIT 1 IS LOCATED AT THE TOP PORTION OF THE CABINET. IT CONSISTS OF A FCD 1000 REGULATOR WITH ITS FRONT PANEL HOUSING THE VARIABLE AND FIXED OSCILLATOR CIRCUITRY, ALL OF THE CONTROLS AND THE OUTPUT TERMINALS. UNIT 2 IS LOCATED AT THE BOTTOM OF THE CABINET. IT ALSO CONTAINS A FCD 1000 REGULATOR, WITH ITS FRONT PANEL HOUSING ALL OF THE OUTPUT FILTER NETWORKS. THE MODULE IS A SMALL SUB-ASSEMBLY LOCATED AT THE CENTERS OF THE CABINET. THIS ASSEMBLY CONTAINS THE STARTING CIRCUITRY FOR BOTH UNITS 1 AND 2. IT ALSO CONTAINS THE PHASE SHIFT NETWORK THAT CONTROLS UNIT 2.

B. TERMINALS & CONTROLS

1. INPUT POWER TERMINALS.

   THE INPUT POWER LINE RUNS THROUGH AN INSULATED BUSHING LOCATED AT THE BOTTOM OF THE REAR PANEL. THE LEADS ARE CONNECTED TO A THREE TERMINAL BOARD MARKED GND. 2-1. THIS BOARD IS LOCATED ON THE BACK OF UNIT 1. IT IS RECOMMENDED THAT A #10 AWG WIRE BE EMPLOYED FOR THE INPUT LEADS. THE GROUND LEAD MUST BE USED IN THIS INSTALLATION.

2. OUTPUT TERMINAL CONNECTIONS.

   THE OUTPUT IS AVAILABLE AT THE FOUR BINDING POSTS LOCATED ON THE FRONT PANEL (UNIT 1). THE INPUT IS ISOLATED FROM THE OUTPUT AND THE ENTIRE CIRCUITRY IS CAPACITOR COUPLED TO THE CHASSIS GROUND. THE OUTPUT IS A WYE CONNECTED FOUR WIRE SYSTEM. DELTA OUTPUT CAN BE OBTAINED BY CONNECTING DELTA LOAD PHASE TO PHASE WITHOUT THE NEUTRAL.

3. INPUT ON/OFF SWITCH.

   THIS SWITCH (SW1) ALSO REFERRED TO AS A "STAND-BY" SWITCH IS LOCATED ON THE LOWER LEFT SIDE OF THE CONTROL PANEL. WHEN THROWN TO "ON" POSITION, ALL OF THE TUBES FILAMENTS WILL LIGHT. THE EXHAUST FAN WILL FUNCTION AND THE INPUT INDICATOR PILOT LIGHT (LOCATED ABOVE THE OUTPUT VOLTAGE SWITCH SW3) WILL LIGHT.

4. OUTPUT ON/OFF SWITCH.

   THE OUTPUT SWITCH (SW3) SHOULD BE TURNED ON APPROXIMATELY 60 SECONDS AFTER THE STAND-BY SWITCH HAS BEEN THROWN. THIS SWITCH (SW3) WILL ALLOW THE COMPLETE UNIT TO FUNCTION.

NOTE: THE UNIT WILL NOT OPERATE IF SUFFICIENT TIME IS NOT ALLOWED FOR THE TIME DELAY RELAY TO ACTUATE.

5. OUTPUT "VOLT ADJ" CONTROL

   THIS CALIBRATED CONTROL IS LOCATED AT THE UPPER RIGHT SIDE OF THE FRONT PANEL. IT WILL PERMIT VOLTAGE ADJUSTMENT BETWEEN PHASE AND NEUTRAL OF 105 TO 125 VAC. HIGHER OR LOWER VOLTAGES ARE AVAILABLE WITH THIS CONTROL BUT ARE NOT GUARANTEED.

6. Frequency Adjust Control

The frequency control is mounted at the center of the control panel. This control will vary the output frequency from 360 to 440 cps.

7. Meter Selector Switch, AB - BC - AC

This switch (S2) located above the "volt adj" control, permits the output meter to indicate any of the three phase to phase output voltages.

8. Fuses

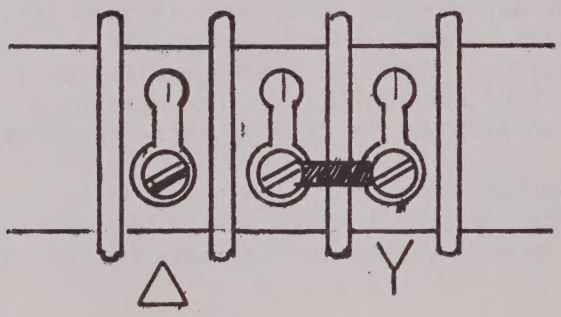
There are six (6) fuses used in this unit. Two fuses (F3 & F4) located on the control panel protect the oscillator and module circuitry. Fuses F1 and F2 protect Unit 1. input circuits, and F5 and F6 protect Unit 2 input circuits. Fuses F1, 2, 5, & 6 are located at the rear of their respective units.

9. OSC/DRV Switch

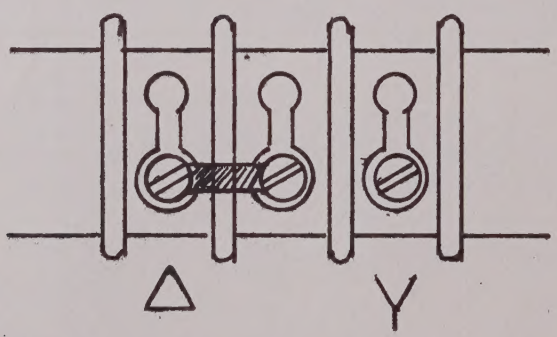
Switch (SW2) is located behind Unit 1 front panel. This switch will permit either the variable OSC or the fixed OSC to function.

OUTPUT CONNECTIONS ARE MADE TO A TWELVE-TERMINAL STRIP TB1. THIS TERMINAL BOARD HAS LINKS WHICH MUST BE POSITIONED TO OBTAIN EITHER WYE (Y) OR DELTA (△) OUTPUT CONFIGURATION.

FOR WYE (Y) OUTPUT ALL LINKS MUST BE AS SHOWN BELOW:

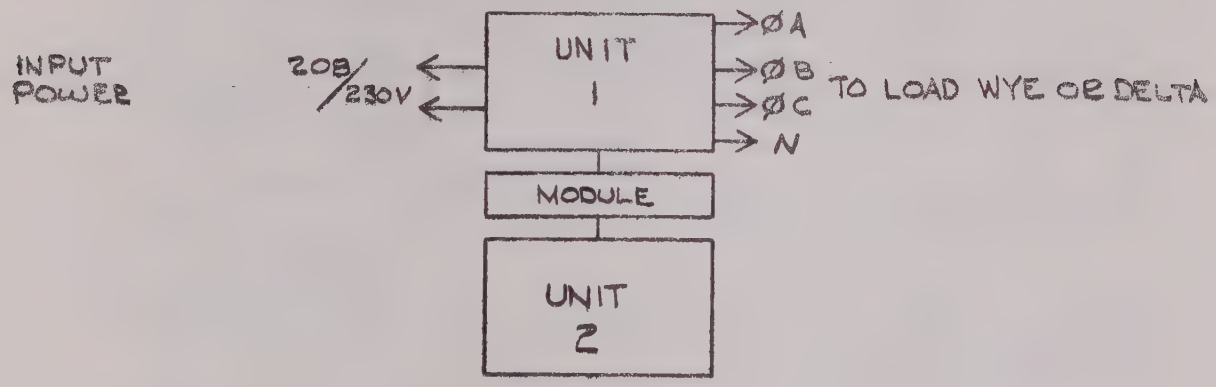


FOR DELTA (△) OUTPUT, ALL LINKS MUST BE CONNECTED AS SHOWN BELOW:

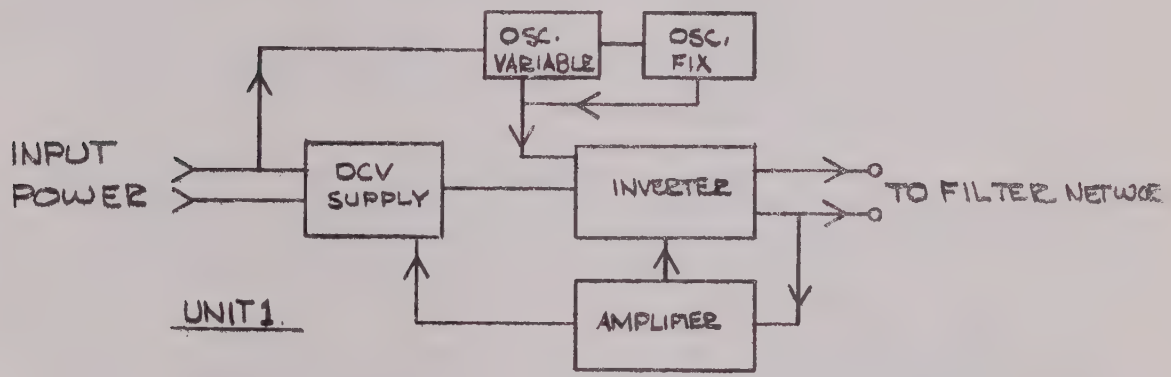


IV. PRINCIPLE OF OPERATION

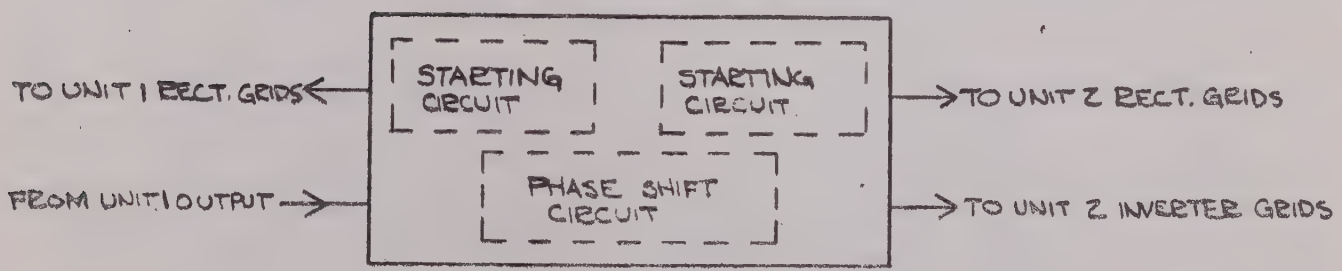
THE OPERATION OF THIS UNIT CAN BEST BE UNDERSTOOD BY REFERRING TO THE SCHEMATIC AND THE BLOCK DIAGRAMS SHOWN BELOW.



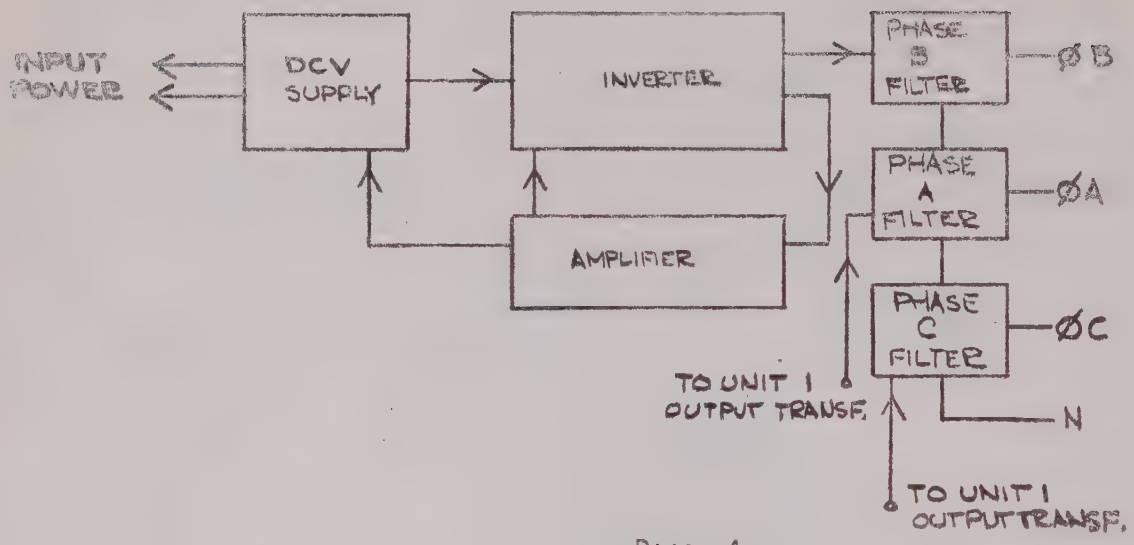
DIAG. 1



DIAG. 2



DIAG. 3



DIAG. 4

A. STARTING CIRCUIT:

THE STARTING CIRCUITS FUNCTION IS TO ALLOW APPROXIMATELY ONE (1) MINUTE TO ELAPSE AFTER SW1 HAS BEEN TURNED ON. THIS IS TO INSURE THAT THE INVERTER AND RECTIFIER TUBES ARE PRE-HEATED PRIOR TO APPLYING B+ VOLTAGE. AFTER ONE MINUTE, THE STARTING CIRCUIT APPLIES A SLOWLY DECREASING NEGATIVE VOLTAGE TO THE GRIDS OF THE RECTIFIER TUBES SO THEY WILL GO ON SLOWLY.

B. D.C.VOLT SUPPLY:

THIS CIRCUIT CONSISTS OF THE INPUT TRANSFORMER (T1) RECTIFIER TUBES V1, V2 AND ITS ASSOCIATED COMPONENTS. THE INPUT POWER IS SUPPLIED TO TRANSFORMER (T1). HERE THE VOLTAGE IS PHASE SHIFTED AND FED TO THE PLATE AND GRID OF RECTIFIER TUBE V1,V2. THIS D.C.VOLTAGE IS THEN FILTERED THROUGH A π TYPE CLC NETWORK AND FED TO THE INVERTER SECTION.

C. INVERTER:

THIS CIRCUIT CONSISTS OF THE OUTPUT TRANSFORMER (T4) INVERTER TUBES V3, V4, COMMUTATING CHOKE (L2) AND CAPACITOR C19, 20. THE B+ VOLTAGE IS IMPRESSED ACROSS THE OUTPUT TRANSFORMER AND THE PLATES OF V3,V4. THE FREQUENCY TO BE MAINTAINED IS FED TO THE GRIDS OF V3, V4. THUS, WHEN THE DC VOLTAGE IS APPLIED, THE TUBE WITH THE POSITIVE GRID BEGINS TO FIRE. THIS BUILDS A VOLTAGE ACROSS THE OUTPUT TRANSFORMER (T4) DEPENDENT UPON THE COMPONENTS OF THE COMMUTATION CAPACITOR AND CHOKE. THE VOLTAGE BUILDS UP UNTIL THE GRID OF THE SECOND TUBE BECOMES MORE POSITIVE THAN ITS CRITICAL GRID VOLTAGE. THIS TUBE NOW FIRES, CUTTING OFF THE FIRST TUBE BY MEANS OF THE COMMUTATING CAPACITOR AND THUS COMPLETING THE CYCLE ACROSS THE OUTPUT TRANSFORMER. THE PROCESS IS CONTINUOUS AT THE FREQUENCY OF THE GRID DRIVE SUPPLY AND PRODUCES A STABLE OUTPUT FREQUENCY.

D. A.C. AMPLIFIER:

THE AMPLIFIER IS DIVIDED INTO TWO SECTIONS. ONE SECTION CONSISTS OF RECTIFIER TUBE V9 WHICH SUPPLIES A D.C. VOLTAGE TO THE DRIVER TUBE V10, A RECTIFIER CR3 SUPPLYING A NEGATIVE VOLTAGE TO V11 AND V12. TRANSFORMER T10 SENSES THE OUTPUT VOLTAGE (ERROR SIGNAL) AND APPLIES THIS CHANGE TO V12 FILAMENTS. SATURABLE CORE REACTOR T5 WHICH REGULATES THE OUTPUT VOLTAGE.

Sequence of Operation: If the output voltage tries to rise, this error signal is impressed across V12 filament, forcing the grid of V10 to become less negative. This negative voltage will cause more D.C. current to flow through the DC coil of T5, reducing the AC inpedance of the SCR and tends to force the output voltage down restoring it to its original value.

The second section consists of input transformer T8, rectifier tube V14 which supplies a DC voltage to a bridge network consisting of R36, R37, R38 and V13.

Sequence of Operation: As the output voltage is controlled by the amount of current fed to T5, this same voltage change is impressed to the grid of V13. Thus, a rise in output will cause the bridge supply to become unbalanced which would change this voltage across C36 in such a direction as to decrease the DC voltage of the main DC supply. I.E. this circuit acts as a variable bias supply for tubes V1 and V2.

E. Variable Frequency Oscillator.

This section is a standard phase shift type oscillator, which provides a square wave drive to Unit 1, inverter tubes V3 and V4.

F. Fixed Oscillator.

This section consists of a precision tuned fork oscillator, which can replace the variable oscillator if the need of a precise output frequency is desired.

G. Phase Shift Network.

Basically this circuit provides the inverter tubes (V3 and V4) of Unit 2 with a stable frequency as does the variable oscillator provide Unit 1 with a stable signal. However, the phase regulationship between these two voltages are 120 degrees out of phase. Transformer T101, V103, L101 constitutes the DC supply for tubes V104, T106, V107. CR105 is another DC supply for tubes V106 and V105.

Sequence of operation: The output voltage of Unit 1 is sampled and phased shifted through the bridge network of T5, R113 and R114. This signal is then fed to transformer T104 which in turn feed the grids of V104. The amplified signal is then tranformed through T102 to the grids of inverter tubes of Unit 2. Transformer T103 senses the output voltage from phase C. This signal is fed to V105 which will regulate the bias voltage of V106. The output of V106 will control the DC current through T5 D.C. coil, thus maintaining the correct angular voltage for Unit 2 inverter tubes.

H. To place the system into operation -

CAUTION - Before operation is begun, please review the preceeding sections with regard to instruction and operations.

1. The input line (208 or 230V) should be connected to the Jones Board at the rear of Unit 1. Use taps 3 & 7 of T1 (T1 in each of Unit 1 and 2) for 208 volt or taps 2 and 8 of T1 for 230 volts.

2. Turn on the ON-OFF switch (SW1). Wait approximately 60 seconds, then turn on the output switch (SW3). Then adjust the controls for the desired output voltage and frequency.

1. Over Current Relay:
   In both Units 1 and 2, there is a relay (K3) which will actuate if the current through the filter circuit exceed the maximum allowable current. This actuation will cause a high negative bias voltage to be applied to the grids of rectifier tubes V1 and V2, preventing the tubes from conducting.

V. MAINTENANCE & TROUBLE SHOOTING AIDS

(A) MAINTENANCE

1. During normal life, the unit requires no maintenance or servicing other than the care usually afforded this type of equipment. Tubes should be replaced at the end of their specified life in accordance with the policies established for the particular application.

2. 2SM15 Tube Data

In almost all cases it will be found that the 2SM15 tube is good if the filament is intact, however, for those customers who wish to set up special tests the following data is included:

Filament - - - - 1.8 volts DC/AC
310 - 335 MA

Plate- - - - - - 500 volts DC
.410 - .550 MADC

Note that the 2SM15 tube is designed so that the filament (cathode) shorts to the plate when the filament opens. This feature is used to lower the output voltage of the frequency changer in the event of 2SM15 tube failure.

(B) SPARE PARTS

All components in the Frequency Changer of a good commercial grace can be expected to give a reasonably long period of trouble-free service. As the age of the instrument increases, however, some components are likely to deteriorate; we therefore suggest that the customer keep on hand the spare parts as indicated by an asterisk on the parts list supplied with the unit. In the event it becomes necessary to replace any part, we strongly suggest that the replacement parts be of the same value as the original. Substitute parts should not be used unless we advise that the substitute part will not impair the performance of the instrument.

(C) REPAIR & TROUBLE SHOOTING

In the event of malfunctioning of the unit due to deterioration or failure of any of its component parts, a systematic checking procedure will provide the quickest and surest method of locating the difficulty. The following section gives systematic checking procedures which should be followed in locating sources of trouble.

CAUTION: DANGEROUR VOLTAGES EXIST IN THIS INSTRUMENT. PLEASE OBSERVE APPROPRIATE PRECAUTIONS.

THE FIRST STEP IN TROUBLE SHOOTING SHOULD BE TO REPLACE TUBES. IN MOST CASES THIS IS ENOUGH TO CURE THE TROUBLE. ALL TUBES, EXCEPT TUBES V1, V2, V3 AND V4 ARE AVAILABLE FROM THE FRONT ONCE THE FRONT PANEL HAS BEEN REMOVED. THIS CAN BE DONE BY REMOVING THE SIX FRONT PANEL SCREWS, THREE AT EACH SIDE OF THE UNIT. BECAUSE OF THE FACT THAT THE FCD 3P-2000 CONSISTS BASICALLY OF TWO FREQUENCY CHANGERS WHOSE OUTPUT PHASE ANGLE RELATIONSHIP IS CONTROLLED. THE GENERAL TROUBLESHOOTING PROCEDURE CAN BE BROKEN DOWN INTO TWO MAIN CATEGORIES ONE, IN WHICH EITHER OF THE TWO FREQUENCY CHANGERS IS MALFUNCTIONING OR ONE IN WHICH THE CIRCUIT CONTROLLING THEIR PHASE ANGLE RELATIONSHIP IS MALFUNCTIONING. IN THE CASE OF THE FORMER IT SHOULD BE DETERMINED WHICH OF THE TWO CHANGERS REQUIRES TROUBLESHOOTING.

1. IF EITHER PHASE FAILS TO START (A-N OR B-N):

A. CHECK TO SEE IF K3 ARE CLOSED INITIALLY. THESE ARE OVER-CURRENT RELAYS AND ARE AVAILABLE BY OPENING THE REAR DOOR. THEY ARE MOUNTED ON RIGHT SIDE OF THE UNIT.

B. CHECK TO DETERMINE THAT NEGATIVE BIAS VOLTAGE DECREASES TO ZERO ACROSS C37 FOR PHASE A AND PHASE B. IF PHASE A FAILS TO START THE TIME DELAY RELAY K3 MAY BE DEFECTIVE.

2. IF EITHER PHASE (A-N OR B-N) STARTS BUT ACTUATES RELAY K3 REMOVE ALL LOADS AND:

A. IF K3 IS ACTUATED CHECK FOR SQUARE WAVE DRIVE AT THE GRIDS OF V3 AND V4. IF DRIVE IS NOT AVAILABLE, CHECK BACK INTO SQUARE WAVE CIRCUIT AND OSCILLATOR CIRCUIT. THE LATTER TWO CIRCUITS ARE IN THE SUB-ASSEMBLY AT THE TOP FRONT FACING THE UNIT.

NOTE 1. PHASE B WILL NOT OPERATE IF PHASE A IS MALFUNCTIONING SINCE PHASE B IS THE DRIVEN PHASE.

NOTE 2. WITH REGARD TO ITEM 2A ABOVE, RELAY K3 WILL CONTINUOUSLY CLICK ON AND OFF UNTIL THE FAULT IS CLEARED OR THE UNIT IS SHUT OFF. THIS FAULT MAY BE LACK OF DRIVE AS MENTIONED ABOVE OR SHORTED LOAD AND LOADS CONSISTING OF LOW IMPEDANCES PRIOR TO WARM UP SUCH AS LAMP BULBS. UNIT WILL ACT IN THE SAME MANNER IF:

A. COMMUTATING CAPACITORS C19 AND C20 ARE SHORTED.
B. COMPONENT L2 IS SHORTED.
C.D DEFECTIVE T4, T5

IF OUTPUT OF PHASE A TO N OR B TO N IS EXCESSIVELY HIGH:

A. DETERMINE WHETHER THE DIODE V12 IN THE CONTROL CIRCUITS IS LIT. THESE CIRCUITS ARE LOCATED BEHIND THE FRONT PANEL OF THE UNIT. THE UPPER SUB-ASSEMBLY IS FOR PHASE A AND THE LOWER FOR PHABE B. IF THIS TUBE IS NOT LIT, THEN CHECK THE VOLTAGE AT TERMINALS 3 AND 4 OF T10 WHICH SHOULD BE APPROXIMATELY 2.0 VOLTS. IF THIS VOLTAGE IS PRESENT, THEN CHECK FOR VOLTAGE AT THE TUBE FILAMENT PINS.

(D) REPAIR CHART

IF THE UNIT STARTS BUT THE OUTPUT IS LOW:

A. CHECK THE DIODE TO SEE IF THE PLATE AND FILAMENT ARE SHORTED. (REFER TO 2SM15 TUBE DATA, PARAGRAPH A2).

B. CHECK THE VOLTAGE ACROSS THE DC COIL, TERMINALS 2 OF T5. IF THIS VOLTAGE CANNOT BE CONTROLLED BY THE OUTPUT ADJ. POTENTIOMETER THE CONTROL CIRCUIT IS NOT OPERATING PROPERLY. THEN CHECK DC VOLTAGE ACROSS C29. IF THIS VOLTAGE IS ZERO, V9 MAY BE DEFECTIVE (OR THE V9 CIRCUIT MAY BE OPEN).

C. CHECK THE REMAINDER OF THE CONTROL CIRCUIT FOR CONTINUITY AND RESISTANCE VALUES.

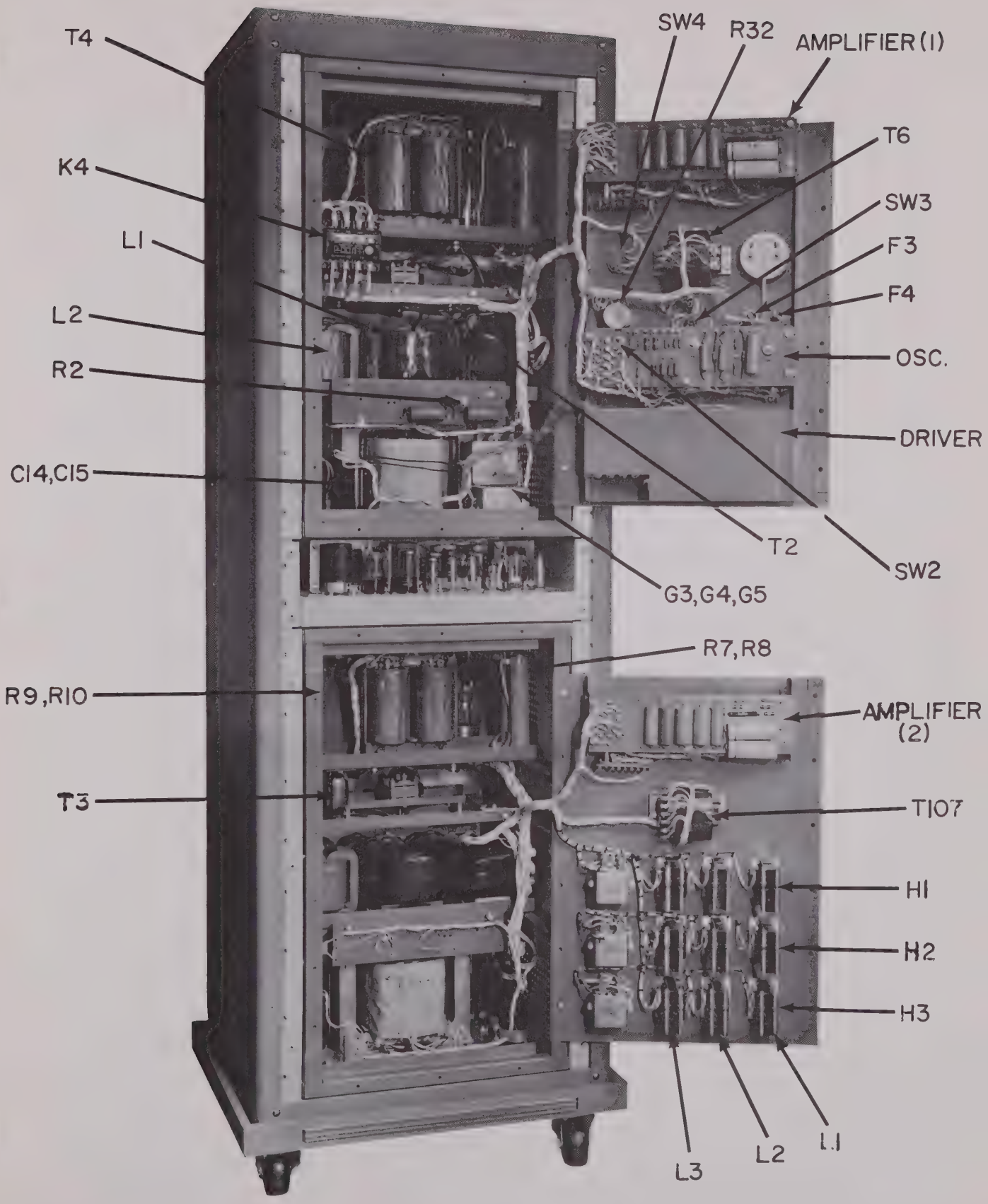
THE ABOVE TROUBLESHOOTING PROCEDURES HAVE BEEN WITH REGARD TO THE TWO FREQUENCY CHANGERS WITHIN THE UNIT. FOLLOWING ARE PROCEDURES TO BE CARRIED OUT OF PHASE ANGLE CIRCUIT MALFUNCTION: (ALL COMPONENTS REFERRED TO ARE IN HE SUB-ASSEMBLY LOCATED AT THE CENTER OF UNIT).

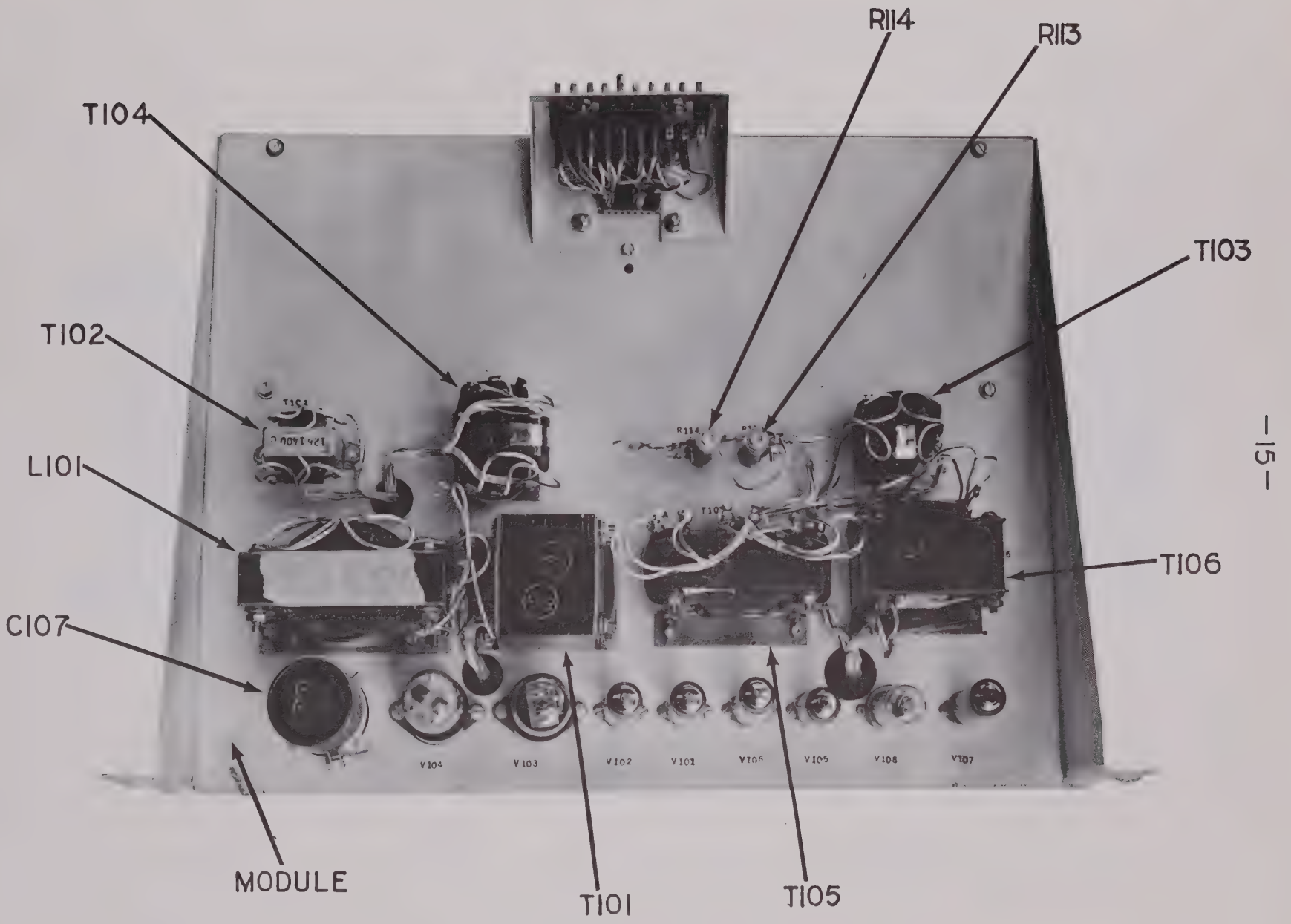
1. IF OUTPUT OF PHASE A TO B IS EXCESSIVELY HIGH:
   - A. CHECK TO SEE IF DIODE V105 IS LIT.
   - B. CHECK CONTINUITY OF RESISTORS R113 AND R114.
   - C. CHECK CONTINUITY OF R117 AND R32C.
   - D. CHECK VOLTAGE AT PINS 3 AND 4 OF T103. THIS SHOULD BE APPROXIMATELY 2.0 VOLTS.

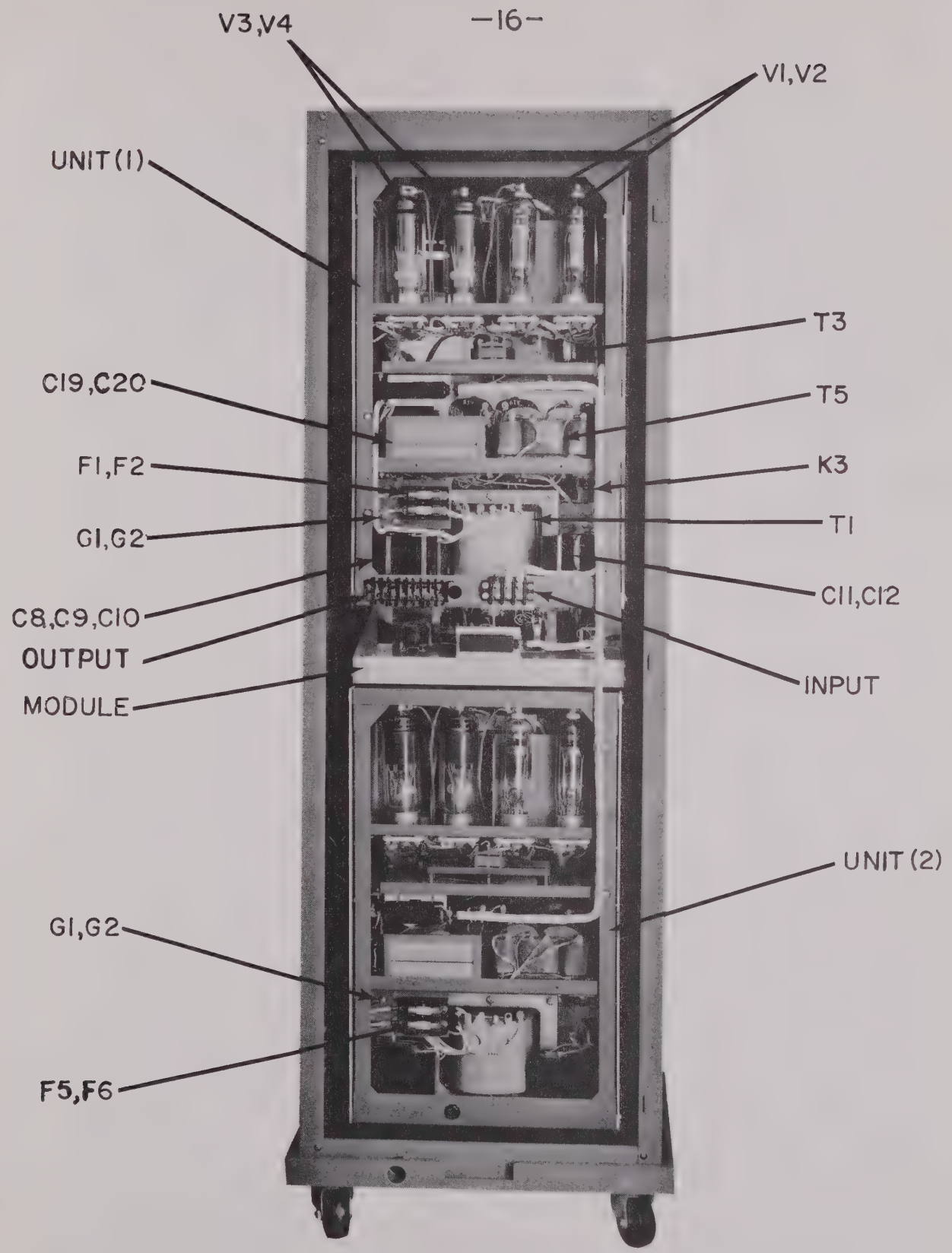
2. IF OUTPUT OF PHASE A TO B IS EXCESSIVELY LOW:
   - A. CHECK FOR DC VOLTAGE ACROSS C33.
   - B. CHECK CONTINUITY OF AC WINDINGS ON T105 (LUGS 1-4)

3. IF OUTPUT OF PHASE A TO B DOES NOT TRACK PROPERLY WITH PHASE TO NEUTRAL VOLTAGES:
   - A. CHECK RESISTANCE OF POT R32C SECTION IN THIS CIRCUIT
   - B. CHECK FOR RESISTANCE UNBALANCE IN BRIDGE CONSISTING OF T105, R113 AND R114.

IN THE EVENT OF SERIOUS DIFFICULTY OR DAMAGE TO THIS INSTRUMENT, WE STRONGLY SUGGEST THAT CONSIDERATION BE GIVEN TO RETURNING IT TO THE FACTORY FOR REPAIR.


T4
K4
L1
L2
R2
C14,C15
R9,R10
T3
SW4
R32
AMPLIFIER (1)
T6
SW3
F3
F4
OSC.
DRIVER
T2
SW2
G3,G4,G5
R7,R8
AMPLIFIER (2)
T107
H1
H2
H3
L3
L2
L1


R114
R113
T104
T103
T102
L101
T106
C107
V104
V103
V102
V101
V106
V105
V108
V107
MODULE
T101
T105


V3,V4
V1,V2
UNIT (1)
T3
C19,C20
T5
F1,F2
K3
G1,G2
T1
C11,C12
C8,C9,C10
OUTPUT
INPUT
MODULE
UNIT (2)
G1,G2
F5,F6

F. T. MAINT. LAB

ASSEMBLY INSTRUCTIONS

FOR

FCD 3P-2000

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ASSEMBLY INSTRUCTIONS

FCD 3P-2000

I. THE COMPLETE SYSTEM IS SHIPPED IN TWO (2) WOODEN CRATES. ONE CRATE CONTAINS UNIT 1 AND UNIT 2, WITH THEIR TUBES SEPERATELY PACKAGED. THE SECOND CRATE CONTAINS THE CABINET, THE MODULE UNIT AND THE INTER-CONNECTING CABLE. THE CABINET CONTAINS ALL THE MOUNTING HARDWARE NECESSARY FOR MOUNTING THE COMPONENTS TO THE CABINET.

II. METHOD FOR ASSEMBLING THE COMPLETE SYSTEM:

1. UNCRATE THE CABINET. REMOVE THE FRONT PANEL AND THE REAR PANEL DOOR. . . . . ALSO REMOVE THE MODULE UNIT AND THE INTERCONNECTING CABLE. RETAIN THE MODULE MOUNTING SCREWS. INSPECT THE CABINET FOR LOOSE HARDWARE OR DEFECTS. NEXT, LAY THE CABINET ON ITS BACK SIDE. REFER TO DIA.1.
2. UNCRATE THE TWO UNITS AND REMOVE THE TUBE PACKAGES FROM THE INDIVIDUAL UNITS. CHECK BOTH UNITS FOR LOOSE HARDWARE AND DEFECTS. BOTH UNITS HAVE PROTECTIVE SHIPPING BRACES PLACED ON VARIOUS COMPONENTS. THESE BRACES MAY BE LEFT ON OR REMOVED. REFER TO DIA.2.
3. REMOVE THE UNITS MOUNTING SCREWS FROM THE CABINET. THERE ARE 36 SCREWS IN ALL. PLACE UNIT 1 (UNIT WITH THE FRONT PANEL CONTROLS) IN THE UPPER PORTION OF THE CABINET. ALIGN THE UNIT AND CABINET MOUNTING HOLES. THEN SECURE WITH SIXTEEN (16) HEX.HEAD MOUNTING SCREWS. REFER TO DIA. 3.
4. NEXT, PLACE UNIT 2 INTO THE LOWER SECTION OF THE CABINET. SECURE UNIT WITH (16) MOUNTING SCREWS.
5. NOW IS REQUIRED ALL THE MANPOWER AVAILABLE. CAREFULLY BRING THE CABINET TO AN UPRIGHT POSITION BEING CAREFUL NOT TO APPLY TO MUCH WEIGHT TO THE REAR WHEELS IN THE PROCESS.
6. PLACE THE MODULE INTO THE CENTER SECTION OF THE CABINET, AND SECURE WITH FOUR (4) MOUNTING SCREWS. NOW ADD THE FRONT PANEL TO THE CABINET WITH THE MOUNTING SCREWS PROVIDED.
7. TAKE THE INTER-CONNECTING CABLE (9) AND PLUG THEM INTO THEIR RESPECTIVE SOCKETS. PLUG 1 TO UNIT 1 SOCKET, PLUG 2 TO UNIT 2 SOCKET, ETC. REFER TO DIA. 4. UNDO THE FOUR CABLE CLAMPS (10) AND INSERT THE INTER-CONNECTING CABLE INTO THESE CLAMPS. NEXT REPLACE THE REMAINING EIGHT TUBES INTO THEIR RESPECTIVE SOCKETS. REFER TO DIA.2.
8. CONNECT THE INPUT POWER LEADS THROUGH THE CABINETS ENTRANCE (14) HOLE TO THE INPUT TERMINAL BOARD (13). REFER TO DIA.4.
9. ATTACH THE CABINET DOOR PANEL TO THE CABINET.
10. THE SYSTEM IS READY FOR OPERATION. REFER TO THE FCD 3P-2000 MANUAL FOR OPERATIONAL INSTRUCTIONS.

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DIAGRAM #1

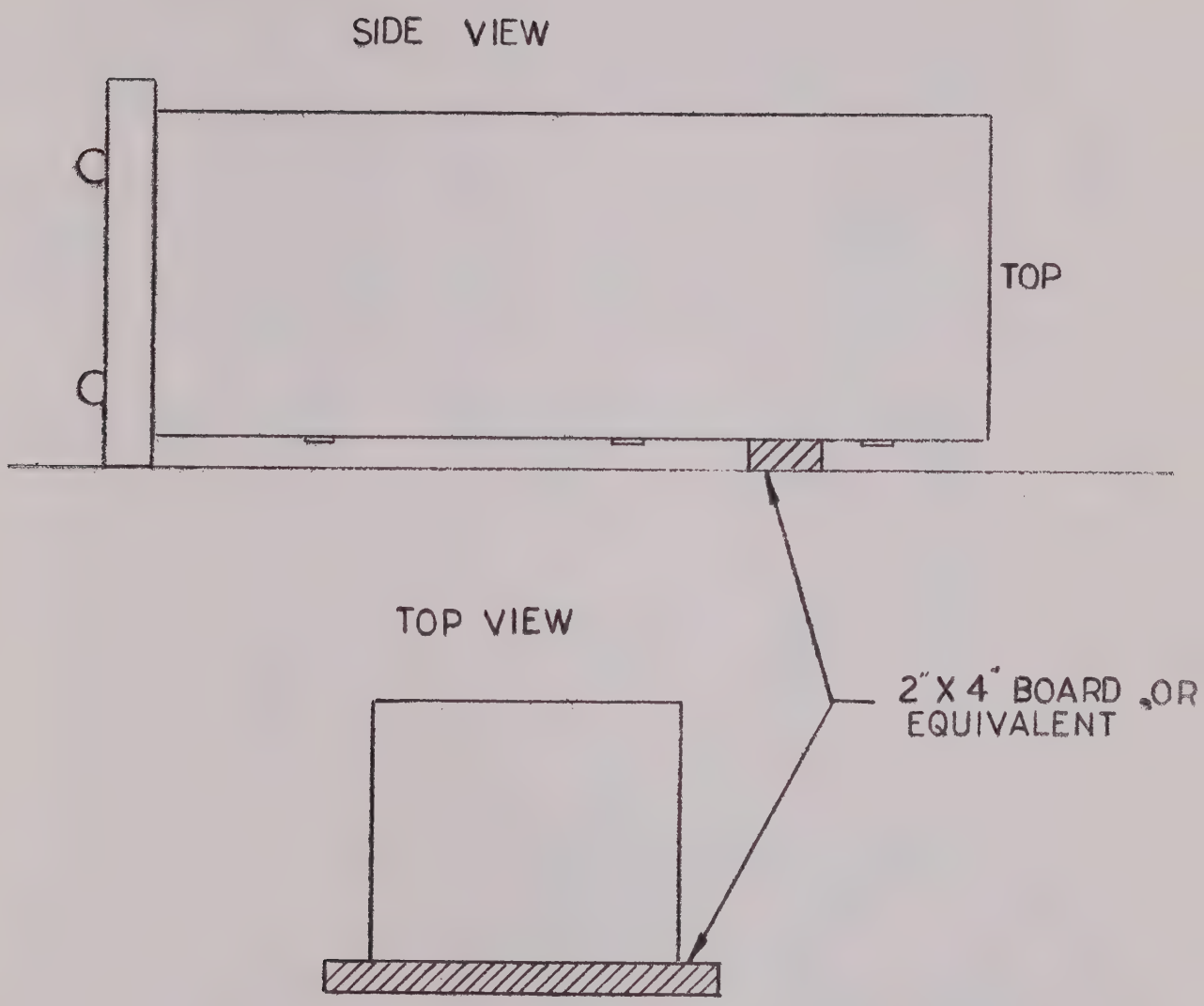

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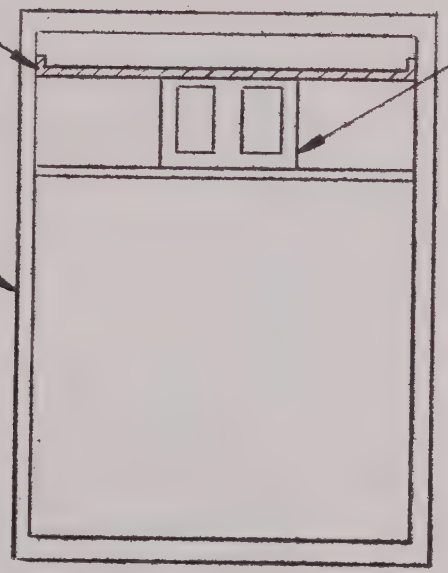
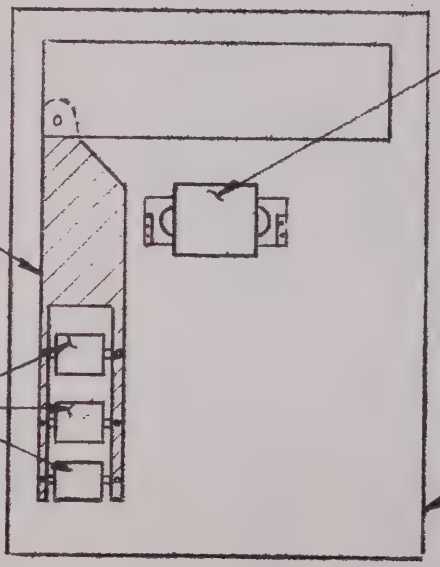
DIAGRAM

FRONT VIEW



REAR OF PANEL



REAR VIEW

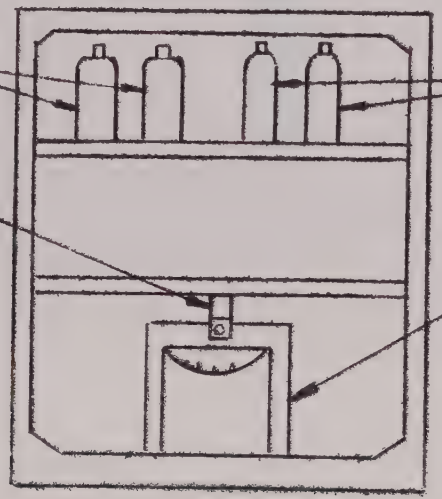
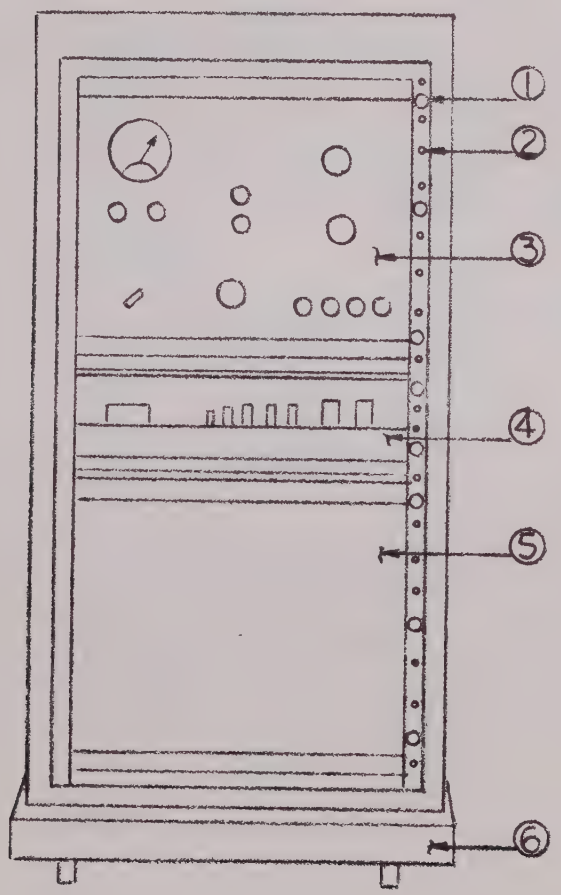
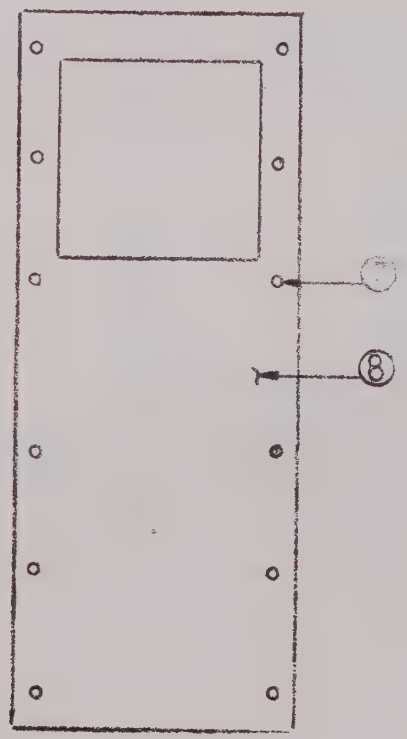


DIAGRAM #3

FRONT VIEW





1. FRONT PANEL MTG. HOLES (2)
2. UNIT 1, UNIT 2 & MODULE MTG. HOLES (36)
3. UNIT 1
4. MODULE
5. UNIT 2
6. CABINET
7. PANEL MTG HOLES (12)
8. FRONT PANEL
9. INTERCONNECTING CABLE
10. CABLE CLAMPS (4)
11. UNIT 1 - INPUT FUSE
12. UNIT 2 - INPUT FUSE
13. INPUT TERMINAL BOARD
14. INPUT LEAD ENTRANCE
15. BACK PANEL
16. HOOK PINS (3PINS)
17. PIN MOUNTS (3MOUNTS)
18. SERIAL NO. NAME PLATE
19. CONNECTOR (3)

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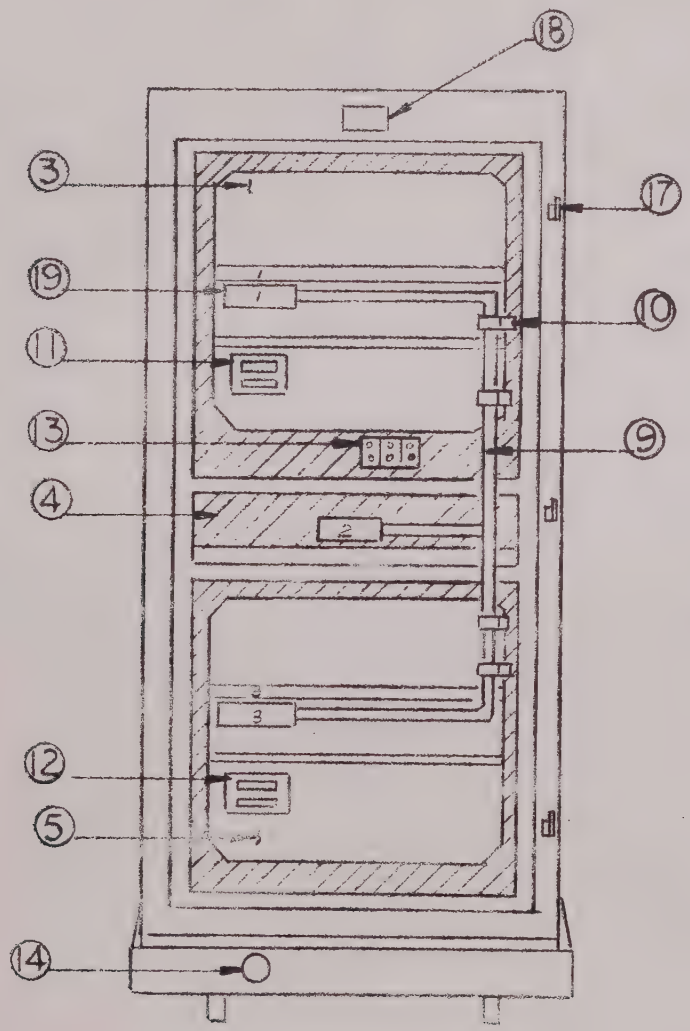
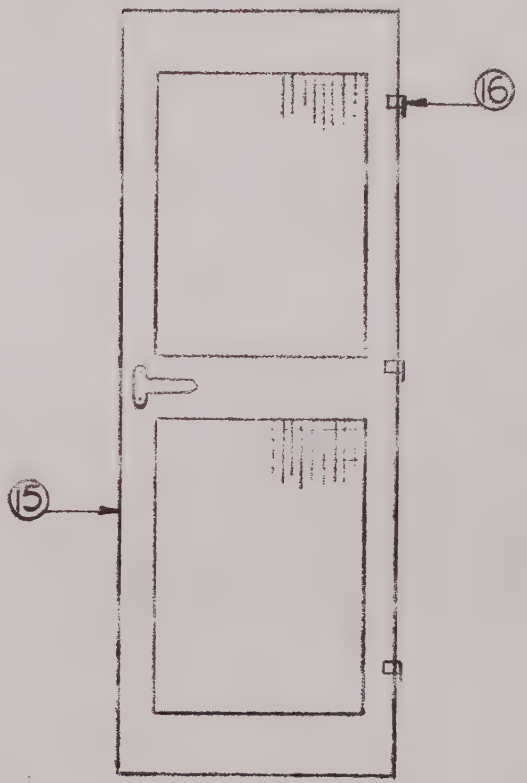
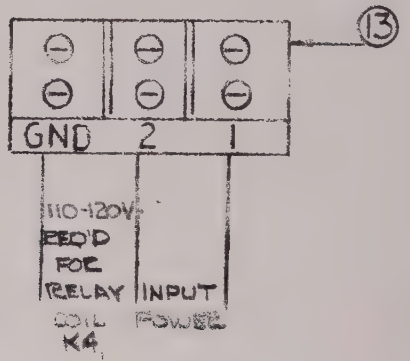
DIAGRAM #4

REAR VIEW







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